INSTRUCTION MANUAL

DUAL HI/LO FILTER

MODEL 1022F

ROCKLAND LABORATORIES, INC.

CERTIFICATE OF COMPLIANCE

Rockland Laboratories, Inc. certifies that this instrument was thoroughly tested prior to shipment and found to meet or exceed its published specifications.

INSTRUCTION MANUAL

DUAL

HI/LO FILTER

MODEL 1022F

ROCKLAND LABORATORIES, INC.
Precision instruments for engineering and the physical sciences
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ROCKLAND LABORATORIES, INC.

MANUAL CHANGES

DUAL HI/LO FILTER

MODEL 1022 F

Serial Number	Change Number
All	1
11-166 and above	1, 2

Change #1	Add C 4, 500 pf, 10%, mica capacitor across J 7
	Add C 5, 500 pf, 10%, mica capacitor across J 17
Change #2	Interchange Assemblies A 5 and A 7 Interchange Assemblies A 15 and A 17 Disconnect S 5 (RC) from A 2 (13) and S 15 (RC) from A 12 (13). Connect S 5 (RC) to A 2 (F) and S 15 (RC) to A 12 (F)

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SPECIFICATIONS

EACH SECTION

1. Transfer Functions: Low Pass, High Pass
2. Response: 4th order Butterworth or RC
3. Attenuation Slope: 24 db/oct
4. Cutoff frequency:
   a. Range:
      Model 1022F-01: 0.01 Hz to 111 KHz
      Model 1022F-02: .001 Hz to 11.1 KHz
      Model 1022F-03: 0.1 Hz to 111 KHz
      Model 1022F-04: .01 Hz to 11.1 KHz
   b. Accuracy: ± 2%
   c. Stability: ± 200 ppm per deg C
5. Attenuation: (for any frequency up to 100 KHz)
   a. At cutoff: Butterworth, 3 db ± 0.5 db
      RC, 12 db ± 1 db
   b. One octave from cutoff (Butterworth): 24 db ± 1 db for four lowest MULTIPLIER positions
      24 db ± 2 db for highest MULTIPLIER position
   c. Two octaves from cutoff (Butterworth): 48 db ± 1 db for four lowest MULTIPLIER positions
      48 db ± 2 db for highest MULTIPLIER position
   d. One decade from cutoff: 76 db min for any frequency up to 1 MHz
6. Passband Response:
   0 db ± 1/4 db) for four lowest
   or 20 db ± 1/4 db) MULTIPLIER positions
   0 db ± 1/2 db) for highest
   or 20 db ± 1/2 db) MULTIPLIER position
7. Amplifier Response: DC to beyond 1 MHz (3 db down)
8. Input Characteristics
   a. Circuit: Single-Ended
   b. Impedance: 10M shunted by 50 pf in 0 db gain
      10M shunted by 100 pf in 20 db gain
   c. Maximum Input Signal (DC plus peak AC)

Gain	Low Pass	High Pass
0 db	10 volts, peak	100 volts, peak
20 db	1 volt, peak	10 volts, peak

9. Output Characteristics
   a. Circuit: Single-Ended

SPECIFICATIONS (cont'd)

b.	Impedance:	50 ohms
c.	Max. Signal:	At least 20 v, p-p / 50 mA p-p to 120 KHz (decreasing at higher frequencies)
d.	Distortion:	Less than 0.05%
e.	Noise: (Input shorted, Detector Bandwidth = 100 KHz)	Less than 0.5 mv rms in either gain setting
f.	Drift:	Does not exceed 1 mv/°C in either gain setting
g.	DC Offset:	At room temperature, dc offset does not exceed 25 mv, in any mode of operation or any dial setting.

SPECIFICATIONS

OVERALL

1.	Transfer Functions:	a. Two sections connected in series High Pass with 48 db/oct attenuation slope Low Pass with 48 db/oct attenuation slope Band Pass with 24 db/oct attenuation slope b. Two sections connected in parallel Band Reject with 24 db/oct attenuation slope, or Sharp Null response
2.	Crosstalk between sections:	Typically – 80 db throughout the tuning range of the instrument
3.	Operating Temperature:	0°C to +50°C
4.	Power Requirements:	115/230 vac, 50-400 Hz, less than 10 watts, or external batteries: 70 mA at ± 20 vdc
5.	Weight:	18 pounds
6.	Configuration:	Bench/Rack convertible, 5¼" H, 17" W, 14" D
7.	Accessories supplied:	Rack mounting kit, Extender Card.

1.0 GENERAL INFORMATION

1.1 DESCRIPTION

The Rockland Laboratories, Inc. Model 1022F Dual Hi/Lo Filter consists of two identical and independent filters mounted side by side in one cabinet, with separate input and output terminals for each section. Each section is a versatile, low-noise, low-distortion solid state filter which provides either low-pass or high-pass response and exact 4th order (24 db/octave) Butterworth or simple RC characteristics. The cutoff frequency is digitally selected over the tuning range of the instrument (See MODELS below). Pass-band gain of unity or 20 db can be selected.

The two sections of the filter can be used individually, or they can be interconnected to obtain band-pass or band-reject response; or to achieve sharper high-pass or low-pass attenuation slopes (48 db/octave).

1.2 MODELS

Model 1022F-01 covers the frequency range from .01 Hz to 111 KHz.
Model 1022F-02 covers the frequency range from .001 Hz to 11.1 KHz.
Model 1022F-03 covers the frequency range from .1 Hz to 111 KHz.
Model 1022F-04 covers the frequency range from .01 Hz to 11.1 KHz.

2.0 INSTALLATION

2.1 INSPECTION

This instrument was carefully inspected and tested prior to shipment. It was operated for at least 100 hours to reduce the probability of early failure. The instrument should be inspected for physical damage incurred in transit and its conformance to specifications verified upon receipt. In case of damage or operational discrepancies, refer to the warranty at the end of this manual.

2.2 POWER REQUIREMENTS

This instrument will operate from either 115/230 VAC, 50-400 Hz, or from external batteries.

Conversion for power line voltage is performed with the rear panel slide switch. Insert a screwdriver in the switch slot

2.2 POWER REQUIREMENTS (cont'd)

and move switch to expose either 115 marking for 115 VAC, or 230 marking for 230 VAC. The instrument is supplied with a $\frac{1}{4}$ Amp slow-blow fuse for either 115- or 230-volt operation, and is shipped with the line voltage selector switch in the 115 VAC position.

When operating on external batteries, they should be connected to the rear panel terminals (+V, -V and Circuit Gnd), observing proper polarities. The instrument is now switched on and off via the rear panel LINE/BATTERY switch. The front panel AC ON switch controls only AC power. The pilot light is inoperative during battery operation to conserve power. Two equal voltage batteries are required. The optimum supply level is 20 volts, but any voltage between 12 and 22 can be used with only minor degradation in performance; i.e., reduced signal swing capability at lower battery voltages and some dc offset voltage.

The instrument is equipped with a three-wire power cable which connects the chassis to earth ground when plugged into a three-contact outlet. If a two-contact outlet is used in conjunction with a three-prong to two-prong adapter, the pigtail of the adapter should be connected to earth ground.

2.3 INSTALLATION

This instrument employs only silicon transistors and it may be operated at any ambient temperature from 0°C to +50°C, without any special ventilation or cooling.

The instrument is normally shipped in its bench configuration. To install in a rack, first remove the feet and tilt stand; then remove the first four flat head screws on each side of the cabinet and attach the angle brackets. Align them flush with the front panel and tighten securely with the hardware supplied.

2.4 FLOATING OPERATION

The chassis of the instrument (available at the rear panel terminal strip) can be dc isolated from circuit ground by removing the shorting link. It may thus be offset with respect to circuit ground (up to 300 vdc).

3.0 OPERATION

3.1 FRONT PANEL DESCRIPTION (Refer to Fig. 3-1)

1. AC ON switch: the switch is moved to the AC ON position to turn the instrument on. It is not used when the rear panel LINE/BATTERY switch is set to BATTERY and the instrument is powered by external battery. The rear panel switch must be in the LINE position when the instrument is powered by the AC line.

2. Response switch: Butterworth (BW) maximally flat response for frequency domain applications, or RC response (transient-free) for time domain applications.

3. CUTOFF FREQUENCY dials indicate the filter setting when multiplied by the MULTIPLIER switch setting. Note that the pilot light is intended to indicate the decimal point location.

4. Pilot light and decimal point indicator: the pilot light is disconnected when the instrument is battery-powered.

5. Input signal terminal.

6. Signal ground terminal.

7. MULTIPLIER switch: selects frequency range of the CUTOFF FREQUENCY dials.

8. GAIN switch: provides gain steps of 0 db and 20 db.

9. FUNCTION switch: selects either HIGH PASS or LOW PASS operation.

10. Output signal terminal.

11. Signal ground terminal.

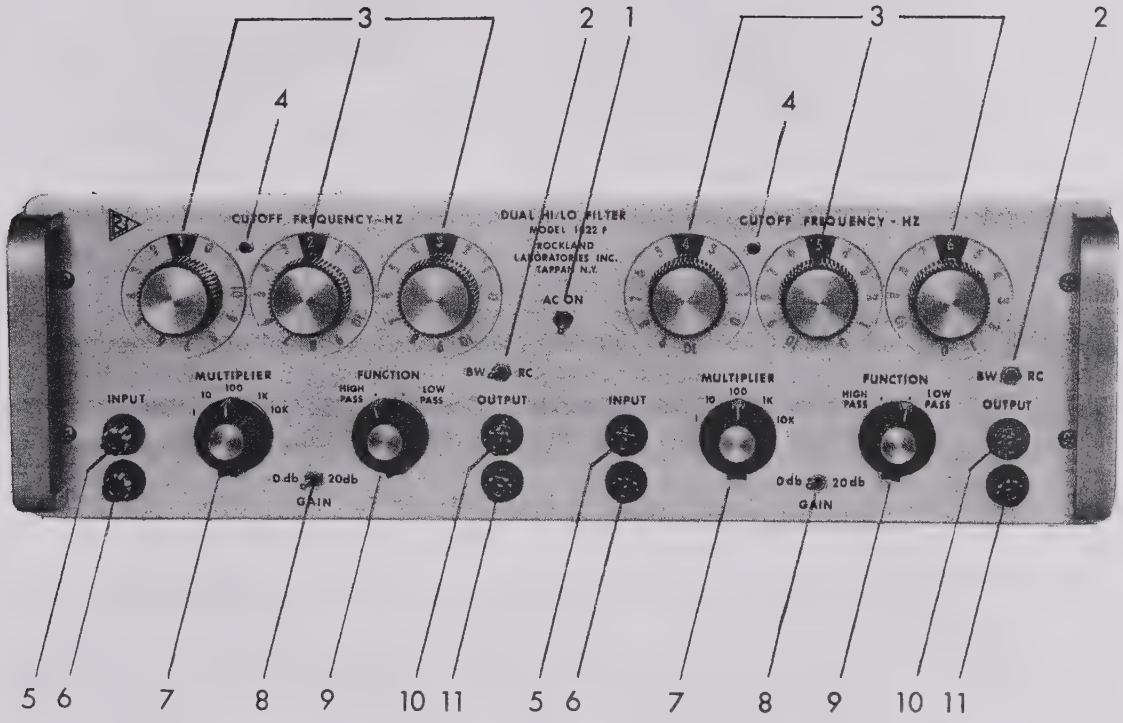

Fig. 3-1. Front Panel Description

3.2 OPERATING INSTRUCTIONS (Refer to Fig. 3-1)

3.2.1 Low Pass Filter

a. Switch on power (AC or battery).
b. Set FUNCTION switch (9) to LOW PASS.
c. Set GAIN switch (8) to 0 db (unity gain) or 20 db (x10 gain).
d. Set CUTOFF FREQUENCY dials (3) and MULTIPLIER (7) to desired setting.
e. Set RESPONSE switch (2) to BW or RC, as desired.

3.2.2 High Pass Filter

a. Switch on power (AC or battery).
b. Set GAIN switch (8) to desired gain.
c. Set CUTOFF FREQUENCY dials (3) and MULTIPLIER switch (7) to desired setting.
d. Set RESPONSE switch (2) to BW or RC, as desired.
e. Set FUNCTION switch (9) to HIGH PASS.

3.2.3 Band Pass Filter

a. Connect the two sections of the filter in series as shown in Fig. 3.2 (a).
b. Set up the left section as a high-pass filter, per para. 3.2.2.
c. Set up the right section as a low-pass filter, per para. 3.2.1.
d. Overall pass-band gain of up to 40 db is available in this configuration.

3.2.3.1 Narrow-Band Operation

a. Set both high-pass and low-pass cutoff frequencies to the same setting (f_0).
b. Set both response switches to BW.
c. Maximum gain in this mode of operation will be 6 db less than the panel markings.
d. The 3 db bandwidth in this mode of operation extends from 80% of fo to 125% of fo and it is equal to 45% of fo.

3.2.4 Band Reject Filter

a. Connect the two sections of the filter in parallel and add the output signals through appropriate summing resistors as shown in Fig. 3.2 (b).

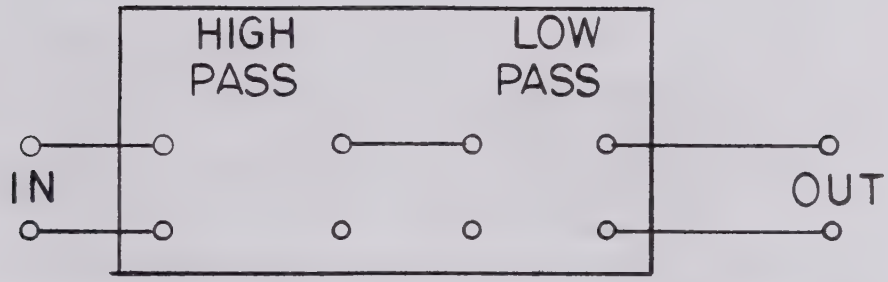

FIG. 3-2(A) BAND PASS CONNECTION

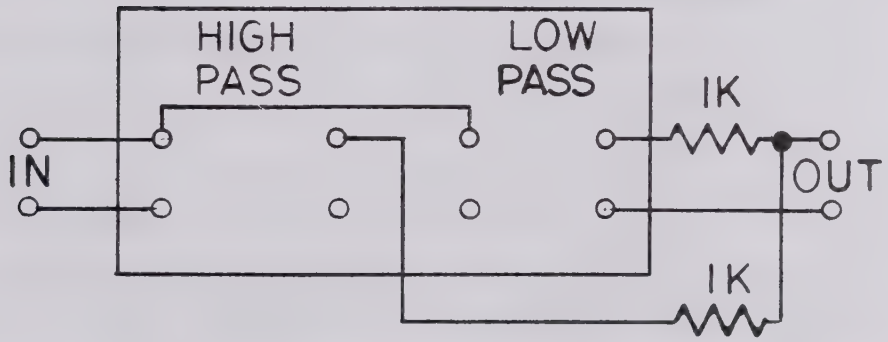

FIG. 3-2(B) BAND REJECT CONNECTION

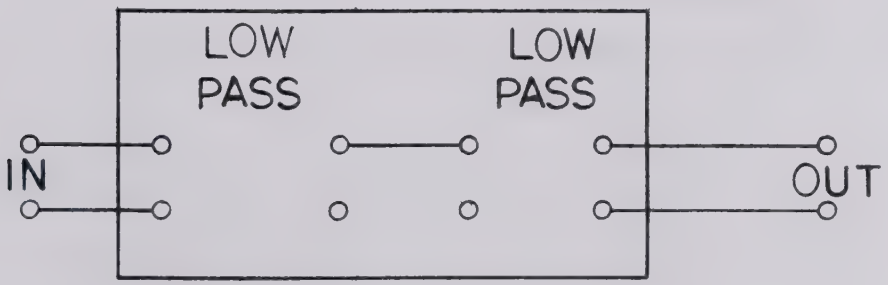

FIG. 3-2(C) CONNECTION FOR HIGHER ORDER RESPONSE (48 DB/OCT)

3.2 OPERATING INSTRUCTIONS (cont'd)

b. Set up one section as a high-pass filter, per para. 3.2.2, with the frequency set at the upper end of the desired rejection band.
c. Set up the other section as a low-pass filter, per para. 3.2.1, with the frequency set at the desired lower end of the rejection band.
d. For sharpest rejection, set both RESPONSE switches to BW.
e. Maximum gain, outside the rejection band, in this mode of operation is 6 db less than the panel markings.

3.2.4.1 Sharp Null Operation

a. Set the high-pass cutoff frequency to twice the desired null frequency.
b. Set the low-pass cutoff frequency to one-half the desired null frequency.
c. Set both RESPONSE switches to BW.
d. Connect CRO or VTVM to the junction point of the summing resistors.
e. Alternatively, adjust high-pass and low-pass CUTOFF FREQUENCY dials for best null.

3.2.5 Low Pass (or High Pass) Filter with increased attenuation slope (Rolloff)

a. Connect the two sections of the filter in series, as shown in Fig. 3.2 (c).
b. Set up both sections identically per para. 3.2.1 (low pass) or 3.2.2 (high pass).
c. The overall attenuation slope will be 48 db/octave.
d. The attenuation at the cutoff frequency will be 6 db, if both response switches are set to BW.
e. The attenuation at the cutoff frequency will be 24 db, if both response switches are set to RC.

3.2 OPERATING INSTRUCTIONS (cont'd)

3.2.6 General Remarks and Rules

The preceding sections on instrument operating procedures have provided step-by-step instructions for setting the various controls in order to utilize the full capabilities of the instrument. Some general remarks and rules are now in order:

1. The CUTOFF FREQUENCY dials and the MULTIPLIER switches should always be set for maximum resolution. For example a cutoff frequency of 5 Hz may be set as follows:

	Freq. Dial	Multiplier
a.	5.00	1
b.	0.50	10
c.	0.05	100

Of the above choices, (a) is the correct setting.

2. A dial setting of 0.00 is meaningless and should be avoided.
3. The output circuitry of the instrument is short-circuit proof. Prolonged short circuits, however, should be avoided at elevated temperatures.
4. When changing MULTIPLIER settings at very low frequencies, faster settling may be achieved by temporarily increasing the cutoff frequency dial setting, and then returning it to the desired setting.

4.0 PRINCIPLES OF OPERATION

4.1 GENERAL DESCRIPTION

This section describes the basic principles of operation of the Model 1022F Dual Hi/Lo Filter. A block diagram of one of the two identical sections of the instrument is shown in Fig. 4.1.

Each section basically consists of two 2nd-order, active RC Butterworth prototypes, whose passive elements are connected in either high-pass, or low-pass configuration via the FUNCTION switch. The input signal is applied through a 10 : 1 attenuator followed by a high input impedance buffer amplifier. The output of this amplifier (block No. 1 in Fig. 4-1) is applied to the cascade of the two Butterworth prototypes whose active elements are indicated by Nos. 2 and 3 in Fig. 4-1. Feedback to the first shunt element of each prototype is applied through buffer amplifiers indicated by Nos. 4 and 5 respectively. Cutoff frequency control is obtained by varying the four resistive elements of the filter in digital steps. The range of the cutoff frequency is changed by varying the four capacitive elements in decade steps.

By changing the amount of feedback to the first shunt element of each prototype, the overall response is changed from Butterworth (maximally flat) to RC (transient free).

4.2 BUTTERWORTH PROTOTYPE

Figure 4-2 is a simplified form of the low-pass Butterworth prototype. The high-pass prototype is identical to the circuit of Figure 4-2 except that the position of resistors and capacitors is interchanged.

The transfer function of the circuit of Figure 4-2 is:

$$\frac{V_o}{V_i} = A \frac{\omega_o^2}{S^2 + 2\beta\omega_o S + \omega_o^2}$$

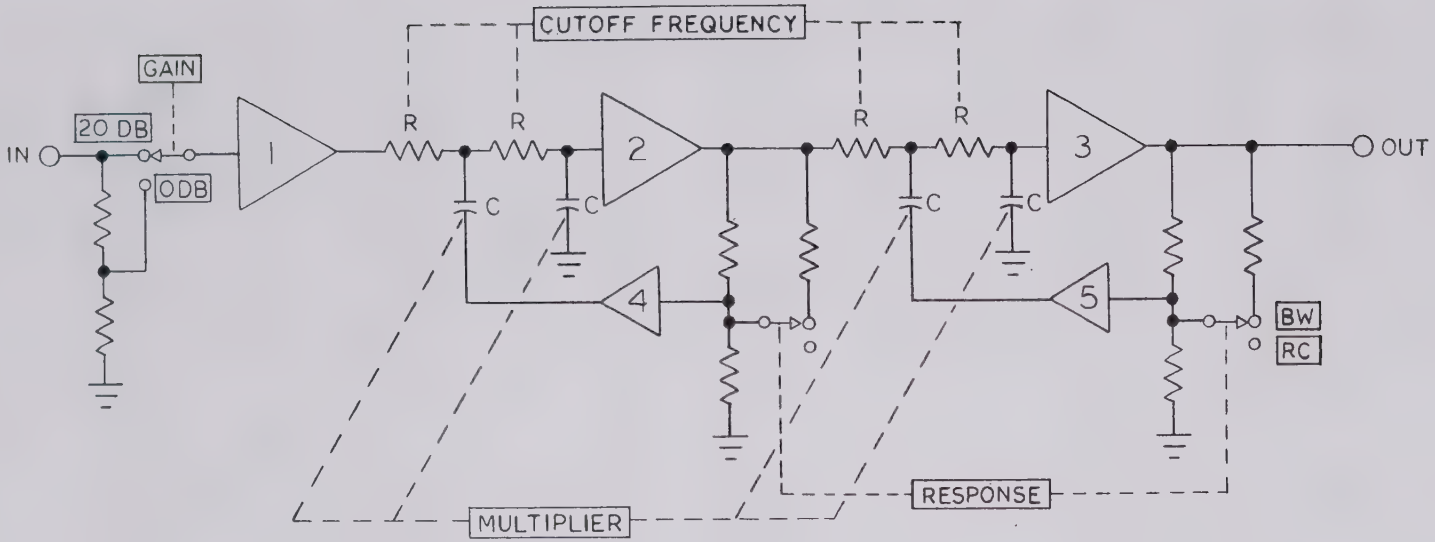

FIG. 4-1. FILTER FUNCTIONAL BLOCK DIAGRAM
(SHOWN IN LOW PASS CONNECTION)

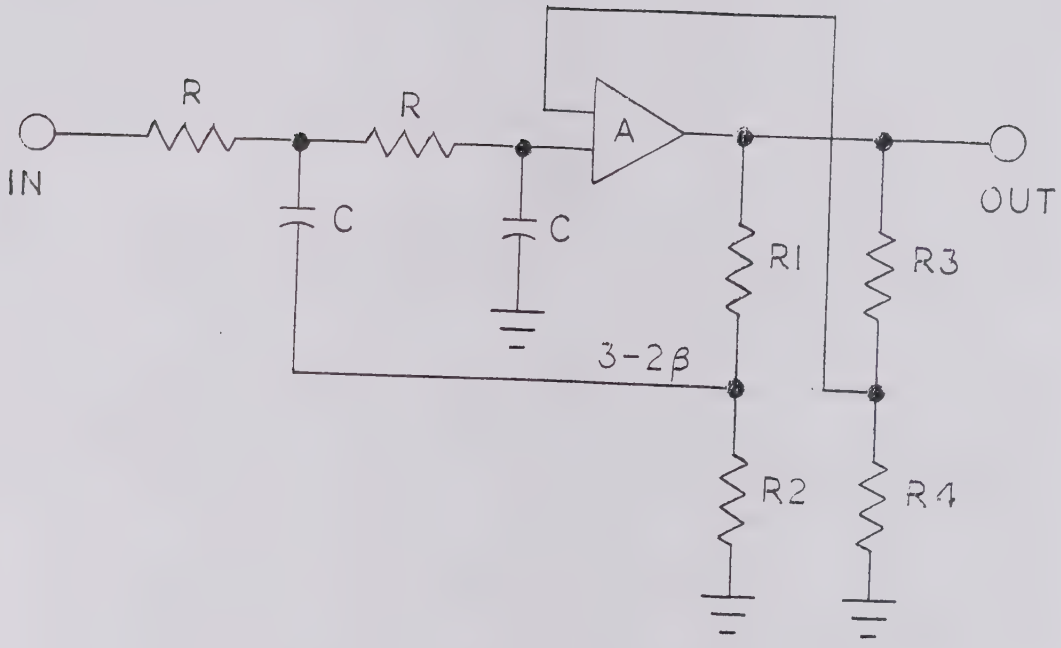

FIG. 4-2. LOW PASS BUTTERWORTH PROTOTYPE

The cutoff frequency is given by:

$$f_o = \frac{1}{2\pi RC}$$

The damping factor β is selected to satisfy the Butterworth factors required to synthesize a 4th-order filter with maximally-flat response (3 db down at the cutoff frequency).

Since a Butterworth-type response is not the optimum for time-domain applications, a switch is provided (BW/RC) which changes the damping of each prototype to critical such that the over-all response obtained is that of a cascade of simple RC sections. This type of response displays no overshoot to a step input, whereas the Butterworth response shows a 10% overshoot. The amplitude and phase response of the filter is shown in Fig. 4.3.

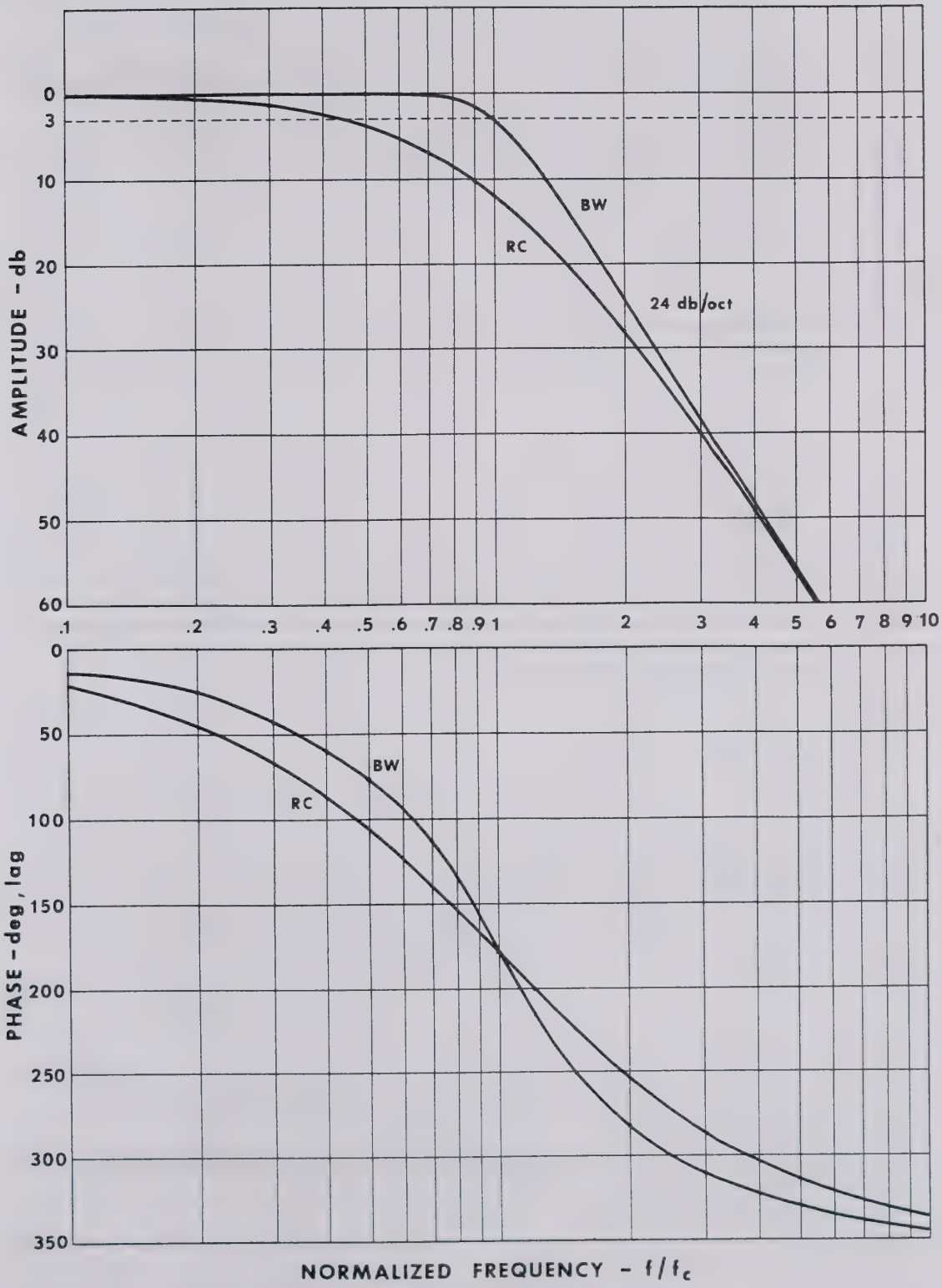

FIG. 4.3-A. LOW PASS FILTER RESPONSE

4.0 PRINCIPLES OF OPERATION (cont'd)

When both sections of the filter are connected for increased attenuation slope (para. 3.2.5), the amplitude and phase response can be obtained from the curves of Fig. 4.3 by multiplying the appropriate parameter (amplitude or phase) by a factor of two. Fig. 4.4-A shows the response obtained when operating in Narrow-Band mode (para. 3.2.3.1) and Fig. 4.4-B shows the Sharp Null response (para. 3.2.4.1).

4.3 POWER SUPPLY ASSEMBLY A1

The power supply assembly provides regulated +20 and -20 volts to all the active circuits of the filter. These voltages are inter-referenced for good tracking. Provision is included for supplying external battery voltages for field operation.

The power supply consists of a transformer with provision for switching its primary for either 115 or 230 vac operation. The transformer is equipped with an interwinding shield to improve isolation from the ac line. Its secondary feeds a full-wave bridge rectifier with capacitive-input filter. The dual regulator which follows provides the required voltages for the active circuits of the filter. The positive side consists of error amplifier A2Q2, reference element A2CR5, amplifier A2Q1 and series pass transistor Q1. The negative voltage is regulated by A2Q3, A2Q4 and Q2.

4.4 MOTHERBOARD ASSEMBLY A2, A12 *

The Motherboard assembly serves to interconnect the plug-in cards and front panel controls. It also contains the input 10:1 attenuator and input stage overload protection circuitry which consists of diodes CR1 through CR4 and resistors R5 and R6. The attenuator (R1, R2) is frequency-compensated with capacitors C1 and C2. The motherboard also contains power supply bypass capacitors and the neutralization capacitors C11 and C15.

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*Assembly numbers A2 through A11 refer to the left section of the filter. Corresponding numbers A12 through A21 refer to the right section. Refer to Fig. 5-1 for assembly location.

4.0 PRINCIPLES OF OPERATION (cont'd)

4.5 OPERATIONAL AMPLIFIER ASSEMBLY A3, A4, A13, A14

The Operational Amplifier assembly consists of a pair of matched, N-type FET's operated in source follower connection (Q1, Q2), which feed an NPN differential stage (Q3, Q4). Q5 is a current bias source, which is temperature-compensated through CR1. The second stage of voltage amplification consists of PNP differential pair Q6, Q7, whose outputs are combined into Class A amplifier Q8. Its output in turn is applied to the load through Class AB complementary emitter followers Q9 and Q10. Diodes CR2 and CR3 provide forward bias and temperature compensation for Q9 and Q10. Frequency compensation is provided by capacitors C1 through C4 and dc balance adjustment by potentiometer R4.

4.6 FEEDBACK ASSEMBLY A5, A15

The Feedback assembly A5, A15 contains the gain resistors for Op-Amp assembly A4, A14, the damping resistors of the first Butterworth/RC prototype, and the buffer amplifier for applying the proper feedback to the first shunt element of the prototype. This amplifier is a unity gain, high efficiency driver providing very low output impedance. Transistor Q1 is an emitter follower, while Q2 and Q3 comprise a Class AB complementary emitter follower stage. Diodes CR1 and CR2 provide forward bias and temperature compensation for Q2 and Q3.

4.7 OPERATIONAL AMPLIFIER ASSEMBLY A6, A16

This assembly is identical to A3, A4, A13, A14 except for one of the frequency-compensation capacitors. This capacitor is reduced in value, in order to provide improved output voltage capability at high frequencies.

4.8 FEEDBACK ASSEMBLY A7, A17

This assembly is similar to A5, A15. It contains the gain resistors for Op-Amp assembly A6, A16, the damping resistors of the second Butterworth/RC prototype, and the same buffer amplifier as in assembly A5, A15.

4.0 PRINCIPLES OF OPERATION (cont'd)

4.9 CUTOFF FREQUENCY SWITCH ASSEMBLIES A8, A9, A10, A18, A19, A20

The cutoff frequency of the filter is controlled in digital steps by assemblies A8, A18 (1st digit), A9, A19 (2nd digit), A10, A20 (3rd digit). Each of these assemblies contains the resistive elements of the filter sections mounted between successive wafers of a switch. All the resistors are fixed, 1% metal film types. There are no trimming or variable resistors.

4.10 MULTIPLIER SWITCH ASSEMBLY A11, A21

The Multiplier assembly controls the range of the cutoff frequency of the instrument. It contains the capacitive elements of the filter sections. The range-switching capacitors are precision (1%) fixed types. There are no trimming capacitors.

The lowest range capacitors are mounted on the chassis because of size. These components are deleted in Options -03 and -04.

5.0 MAINTENANCE

5.1 TEST EQUIPMENT

The required test equipment and its use is listed in the accompanying table.

Instrument Type	Model	Use
DC Voltmeter	Simpson 269 HP 425	DC measurements DC adjustments
AC Voltmeter	HP 400 FL Ballantine 320	Frequency response Noise measurement
Oscilloscope	HP 140A	Waveform checking
Sine-wave Oscillator	HP 4204A HP 203A	Frequency response
Band-Reject Filter	RLI 1000F	Distortion measurements

5.2 CALIBRATION

Filter gain and cutoff frequency accuracy may be determined by conventional point-by-point techniques. The cutoff frequency is defined by the intersection of the Bode plot asymptotes and it should be within $\pm$ 2% of dial setting.

The attenuation at the cutoff frequency should be 3 db for Butterworth response, or 12 db for RC response. The phase shift at the cutoff frequency should be 180 degrees.

5.0 MAINTENANCE (cont'd)

5.3 ADJUSTMENTS

The only adjustments in the instrument are the power supply voltage adjustment A1R8 and A1R9; the operational amplifier balance control R4; the attenuator frequency compensation capacitor A2C1, A12C1; and the neutralization capacitors A2C11, A12C11 and A2C15, A12C15. All these adjustments have been performed at the factory. Should it be determined that the instrument is out of adjustment, the following procedure should be employed.

5.3.1 Cover Removal

Unscrew and remove the screws that secure each cover and remove both top and bottom covers.

5.3.2 Power Supply Adjustment

a. Connect DC Voltmeter between J7 black post (gnd) and pt 16 of Motherboard assembly A2.
b. Adjust R8 of power supply assembly A1 for voltmeter reading of +20.0 vdc.
c. Move DC voltmeter connection to pt. 19 of Motherboard assembly A2.
d. Adjust R9 of A1 for voltmeter reading of -20.0 vdc.

CAUTION

a. Do not reverse above procedure as adjustment of R8 affects -V due to inter-referencing of the two supplies.
b. Be careful not to short together points 16 and 19.

5.3.3 DC Balance Adjustment

This adjustment may be made if the output dc level becomes objectionably high (positive, or negative). This may occur if the instrument is battery-powered and the batteries used are appreciably different from 20 volts. In this case, the adjustment should be performed with the instrument powered by the batteries after at least 30 minutes warmup. Proceed as follows:

a. Place a short across input connector J6.
b. Set up the left section as high pass filter per

5.0 MAINTENANCE (cont'd)

para. 3.2.2 with RESPONSE switch in either BW or RC position, at a cutoff frequency of 1000 Hz.
c. Set GAIN switch to 20 db.
d. Connect DC voltmeter (HP 425) or direct-coupled CRO at 5 mv/cm vertical sensitivity between J7 black post and pt A of assembly A3.
e. Adjust A3R4 for best null.
f. Disconnect meter lead from pt A and connect to J7 red post.
g. Adjust A6R4 for best null.
h. Rotate FUNCTION switch to LOW PASS.
i. Adjust A4R4 for best null.
j. Move FUNCTION switch alternately from LOW PASS to HIGH PASS positions. If output dc level changes appreciably (more than 25 mv) repeat steps d through i.
k. Repeat steps a through j and perform corresponding adjustments on the right section of the instrument.

5.3.4 Attenuator Compensation Adjustment

a. Set up the left section as high pass filter per para. 3.2.2 with RESPONSE switch in BW position at a cutoff frequency of 1 Hz.
b. Set GAIN switch to 0 db.
c. Connect 1 KHz square-wave generator to INPUT terminals.
d. Connect CRO to OUTPUT terminals.
e. Insure that output level is below clipping and adjust A2C1 for best square-wave response.
f. Repeat steps a through e and perform corresponding adjustment (A12C1) on the right section of the instrument.

5.3.5 Neutralization Capacitor Adjustment (x10K Adjustment)

a. Set up the left section as low pass filter per para. 3.2.1 with RESPONSE switch in BW position, GAIN switch in 20 db position and CUTOFF FREQUENCY and MULTIPLIER at 5.00 x 1K.
b. Connect AC voltmeter (HP 400 FL) between output black post (gnd) and pt A of assembly A5.
c. Connect sine-wave oscillator (HP 4204A) to INPUT terminals. Set its frequency to 5.000 KHz.
d. Increase oscillator amplitude until voltmeter reads 1.0 vrms.
e. Rotate MULTIPLIER switch to the 10 K position and change oscillator frequency to 50.00 KHz. (Check that oscillator amplitude remains constant). If voltmeter reading changes, adjust A2C11 until no change in the reading is observed.
f. Remove voltmeter lead from pt A and connect to output red post.
g. Repeat steps c through e, but adjust A2C15 instead of A2C11.
h. Repeat steps a through g and perform corresponding adjustments on the right section of the instrument.

TOP VIEW

BOTTOM VIEW

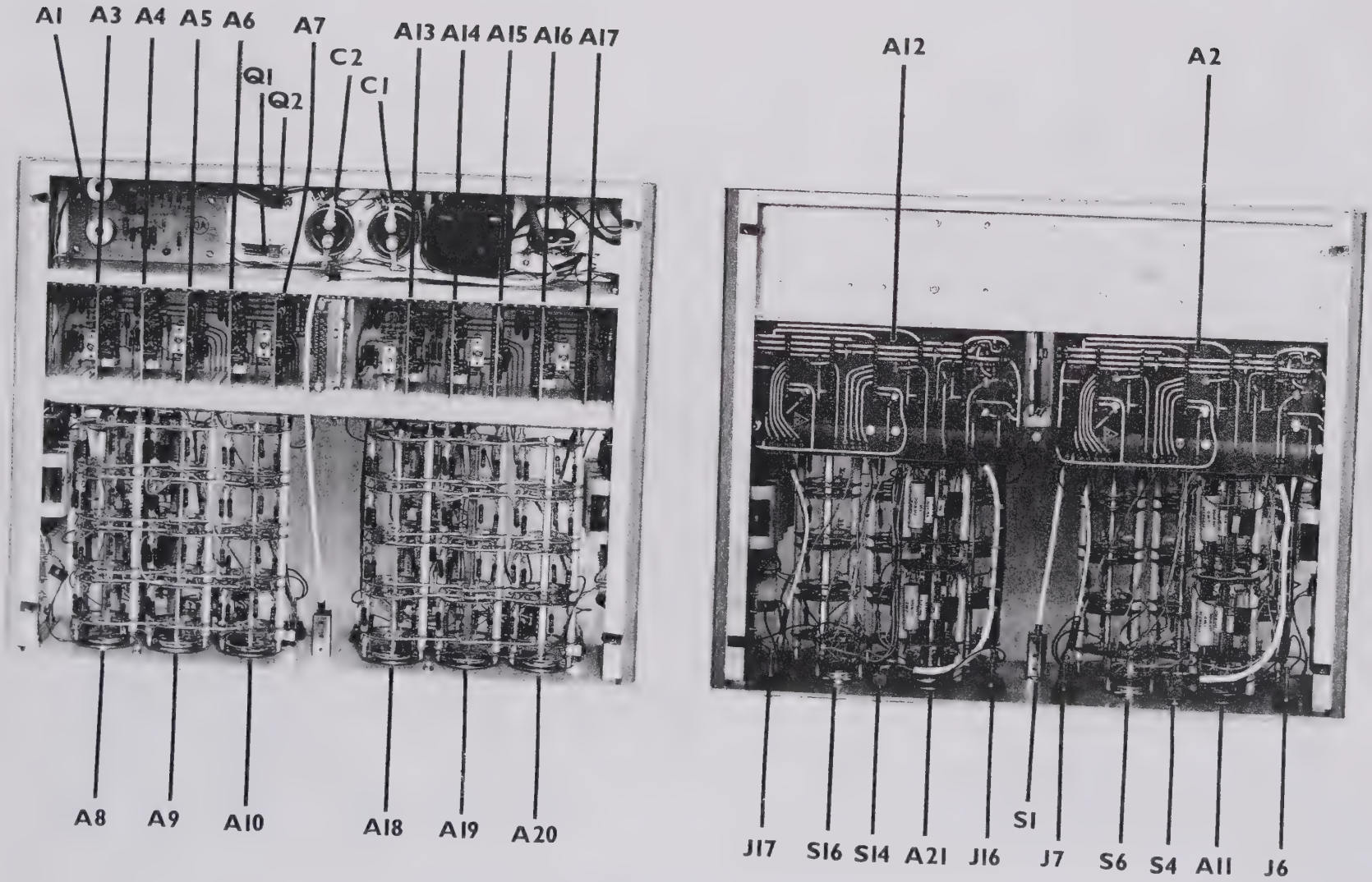
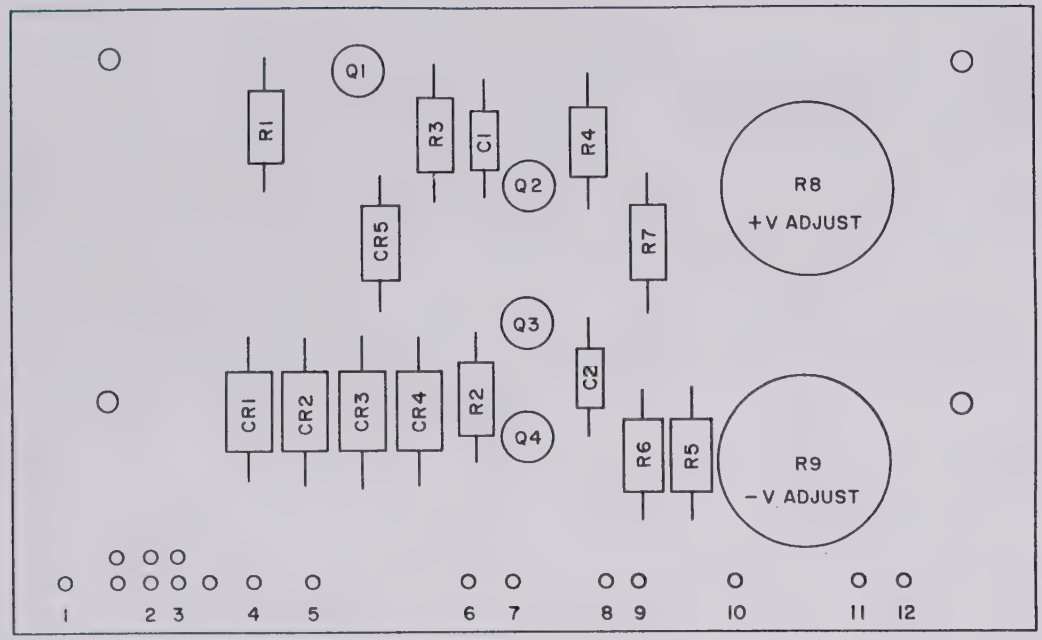


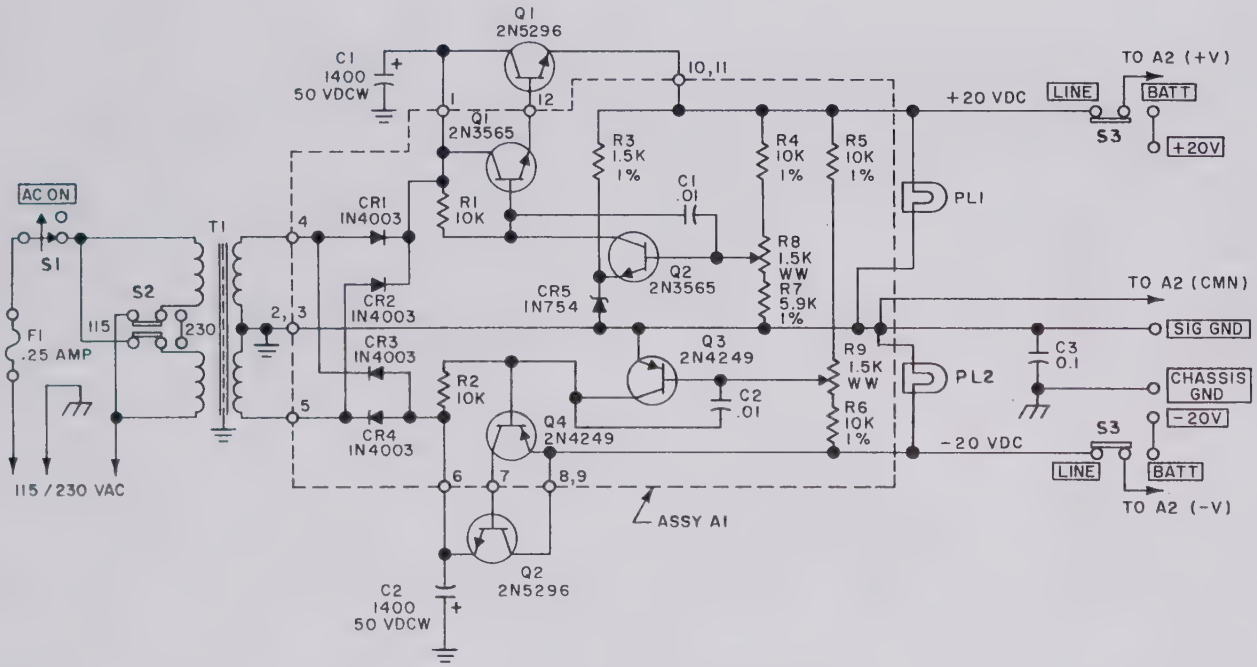
Fig. 5-1. Assembly & Parts Location

DATE	SYM	REVISION RECORD	AUTH.	DR	CK.



TOLERANCES (EXCEPT AS NOTED)	ROCKLAND LABS , INC.		
DECIMAL ±		SCALE	DRAWN BY J.R. APPROVED BY SNT
FRACTIONAL ±	TITLE POWER SUPPLY ASS'Y A1		
ANGULAR ±	DATE 11-3-68	DRAWING NUMBER 112420	

DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.



NOTES

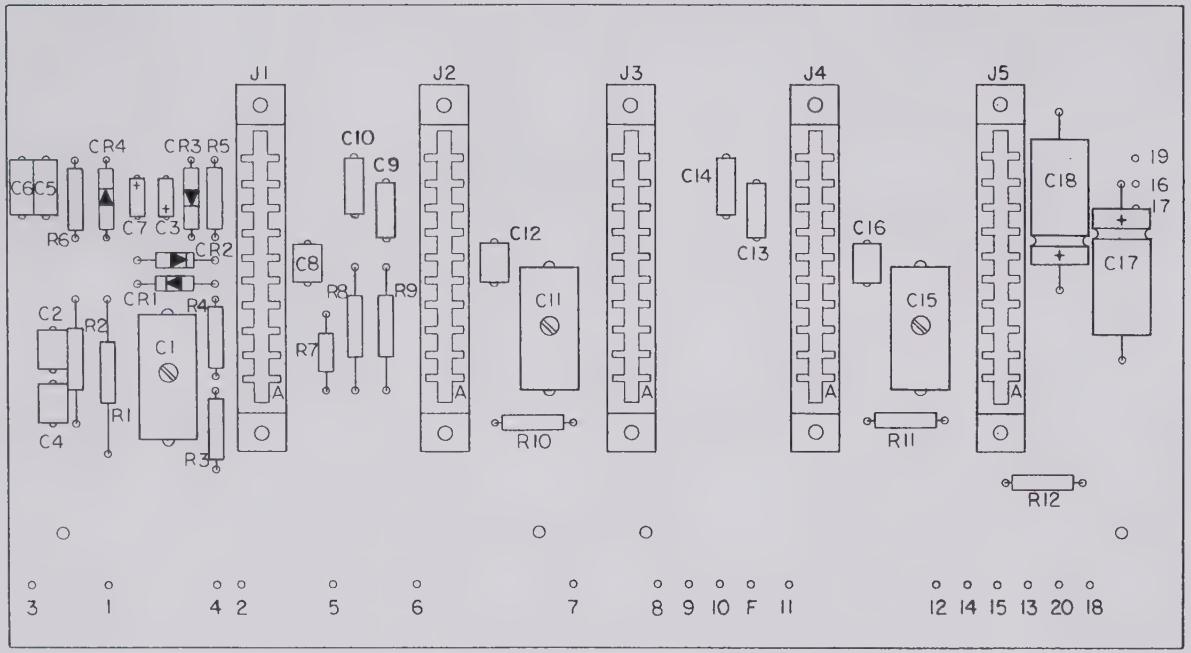
1. REFERENCE DESIGNATIONS ON THIS ASSY. ARE ABBREVIATED. ADD ASSY. DESIGNATION AS PREFIX TO FORM COMPLETE DESIGNATION.
2. UNLESS OTHERWISE SPECIFIED:
   RESISTANCE IN OHMS, ±5%.
   CAPACITANCE IN MICROFARADS.
3. SYMBOLS:
   SIGNAL GROUND
   CHASSIS GROUND

ASSEMBLY A1

TOLERANCES (EXCEPT AS NOTED)	ROCKLAND LABS, INC.		
DECIMAL ±		SCALE	DRAWN BY J.R.
			APPROVED BY SNT
FRACTIONAL ±	TITLE POWER SUPPLY SCHEMATIC DIAGRAM		
ANGULAR ±	DATE 11-1-68	DRAWING NUMBER 112572	

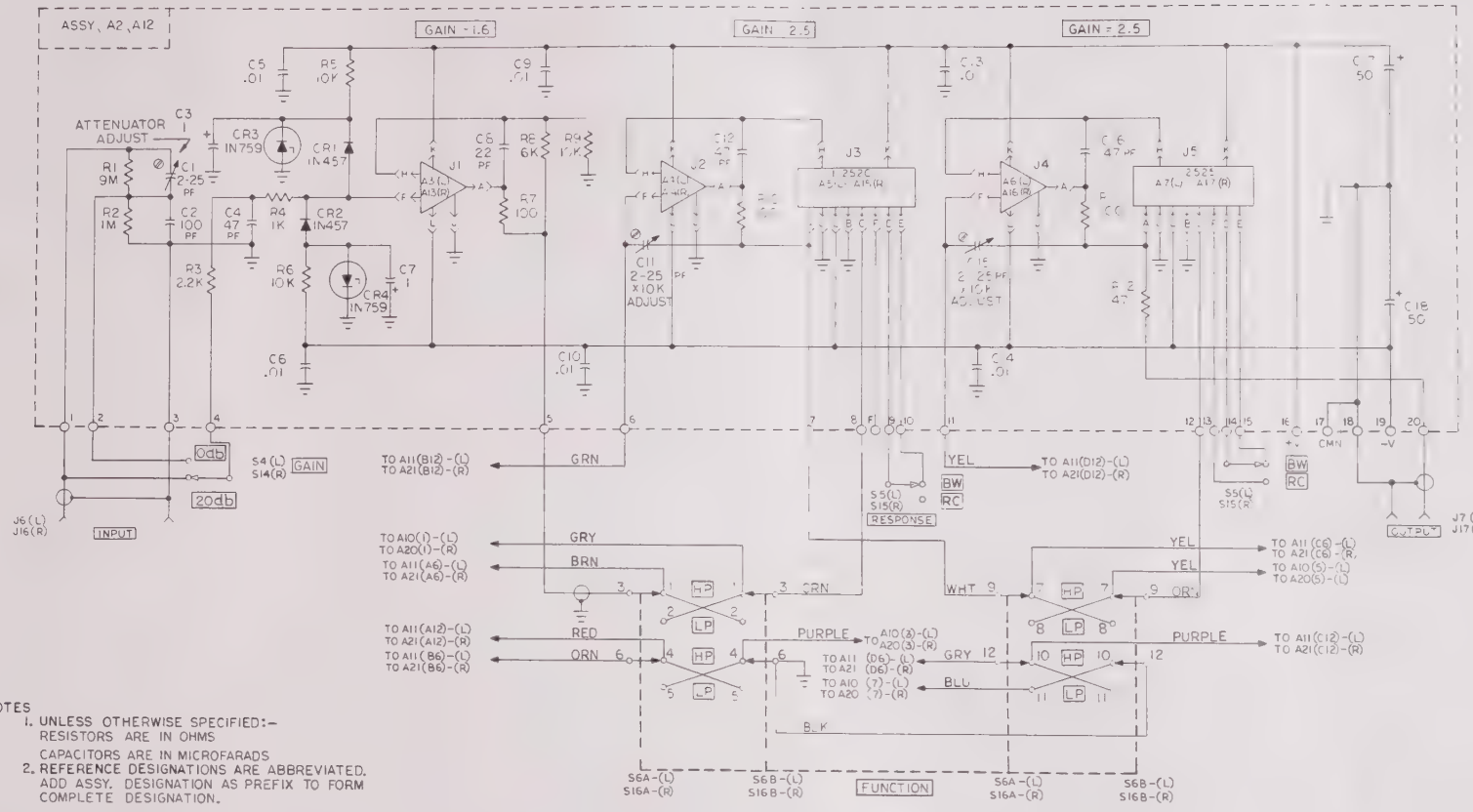
K&E ALBANENE © 10 6400
MADE IN U.S.A.

DATE	SYM	REVISION RECORD	AUTH.	DR	CK.



ASSY A2, A12

MATERIAL:	TOLERANCES (EXCEPT AS NOTED)	ROCKLAND LABS INC.			
FINISH:	DECIMAL ±		SCALE 2/1	DRAWN BY W.K.	
				APPROVED BY SNT	
	FRACTIONAL ±	TITLE MOTHERBOARD ASSY			
	ANGULAR ±	DATE 2-4-69	DRAWING NUMBER 112515		REV.
NEXT ASSY.	QTY 2				



NOTES

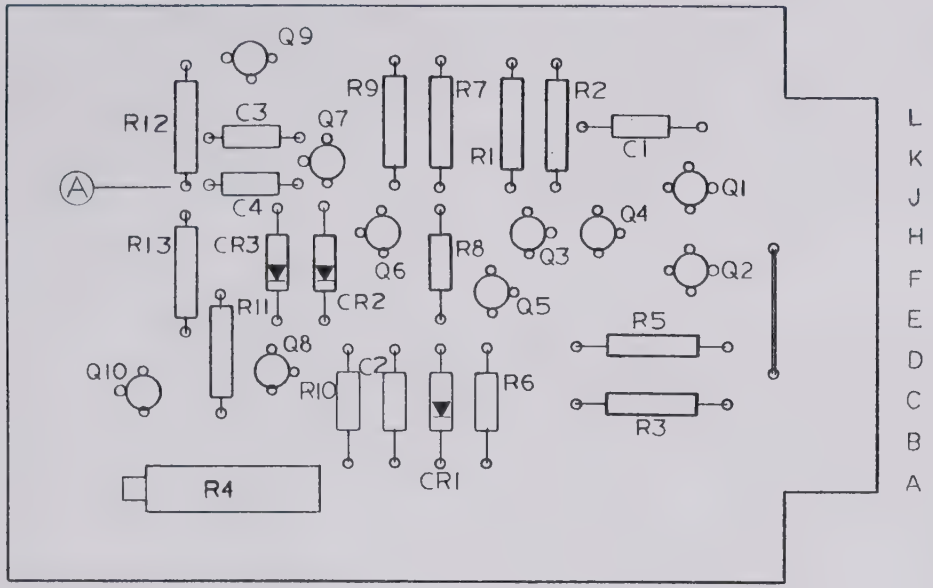
1. UNLESS OTHERWISE SPECIFIED:-
   RESISTORS ARE IN OHMS
   CAPACITORS ARE IN MICROFARADS
2. REFERENCE DESIGNATIONS ARE ABBREVIATED. ADD ASSY. DESIGNATION AS PREFIX TO FORM COMPLETE DESIGNATION.

DATE	BY	REVISION RECORD	APPR.	DR.	CK.

ASSY A2, A12

TOLERANCES (EXCEPT AS NOTED)	ROCKLAND LABS INC.
DECIMAL ±	SCALE NONE; DRAWN BY W.K; APPROVED BY S.M.T
FRACTIONAL ±	TITLE MOTHERBOARD ASSY SCHEMATIC DIAGRAM
ANGULAR ±	DATE 1-27-69; DRAWING NUMBER 125-6; REV.

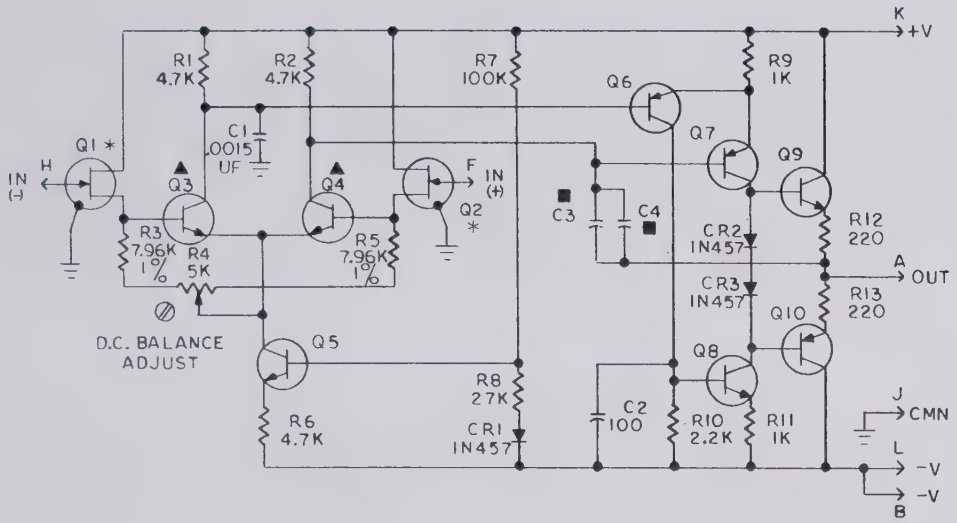
DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.



ASSY A3, A4, A6, A13, A14, A16

TOLERANCES (EXCEPT AS NOTED)	ROCKLAND LABS INC.		
DECIMAL ±		SCALE 2/1	DRAWN BY W.K.
			APPROVED BY SNT
FRACTIONAL ±	TITLE OPERATIONAL AMPL. ASSY.		
ANGULAR ±	DATE 2/14/69	DRAWING NUMBER 112540	REV

DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.



NOTES:

1. ✱ INDICATES MATCHED PAIR MFE 2093 OR EQUIV.
2. ▲ INDICATES MATCHED PAIR 2N3565
3. Q5, Q8, Q9 ARE 2N3565
4. Q6, Q7, Q10 ARE 2N4249
5. UNLESS OTHERWISE SPECIFIED:
   RESISTORS ARE IN OHMS
   CAPACITORS ARE IN UUF
6. ■ INDICATES FACTORY SELECTED VALUE
7. REFERENCE DESIGNATIONS ARE PARTIAL
   FOR COMPLETE DESIGNATION ADD
   ASSY. NO. E.G. A1R12

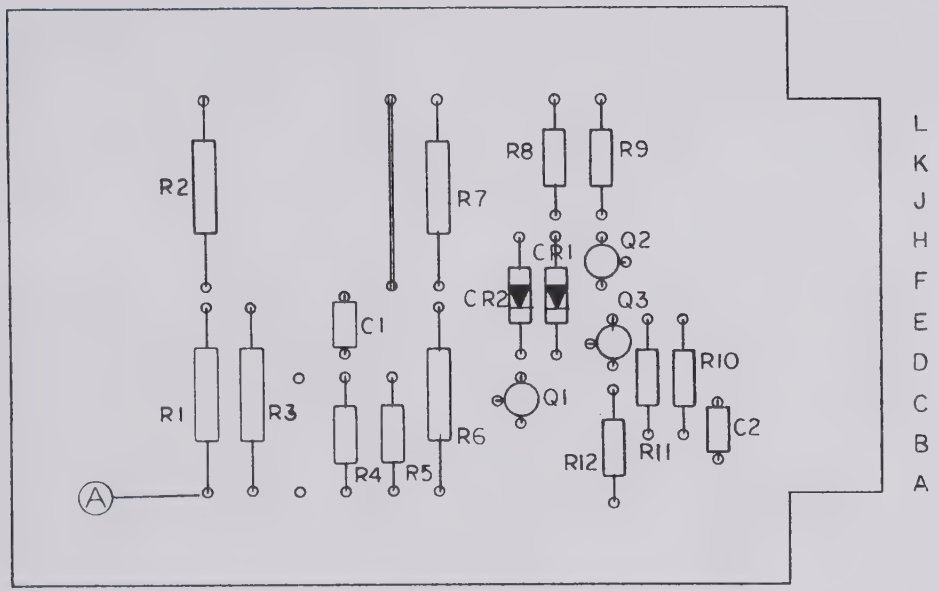
ASSY A3, A4, A6, A13, A14, A16

TOLERANCES (EXCEPT AS NOTED)	ROCKLAND LABS INC.		
DECIMAL ± —		SCALE —	DRAWN BY W.K.
			APPROVED BY SNT
FRACTIONAL ± —	TITLE OPERATIONAL AMPLIFIER SCHEMATIC DIAGRAM		
ANGULAR ± —	DATE 2/14/69	DRAWING NUMBER 112541	REV.

ALBANENE © 10 5400

MADE IN U.S.A. 28570

DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.



TOLERANCES (EXCEPT AS NOTED)	ROCKLAND LABS, INC.		
DECIMAL ±		SCALE 2/1	DRAWN BY W.K.
			APPROVED BY SNT
FRACTIONAL ±	TITLE FEEDBACK ASSY A5, A15		
ANGULAR ±	DATE 2/12/69	DRAWING NUMBER 112520	REV

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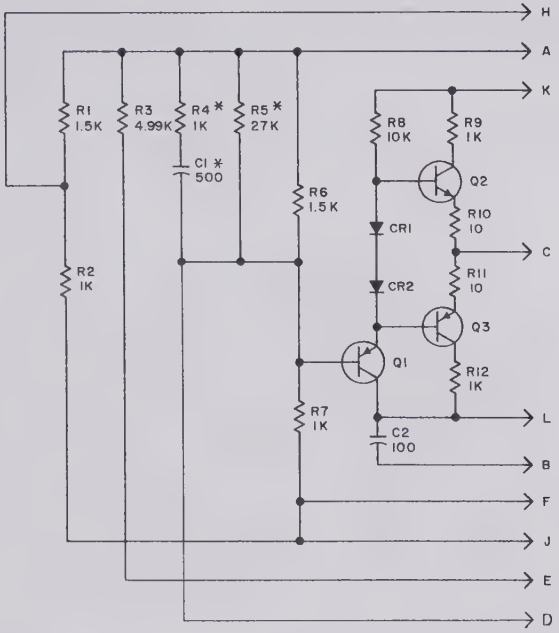
MADE IN U.S.A.

DATE	SYM.	REVISION RECORD	AUTH.	DR.	CK.



NOTES

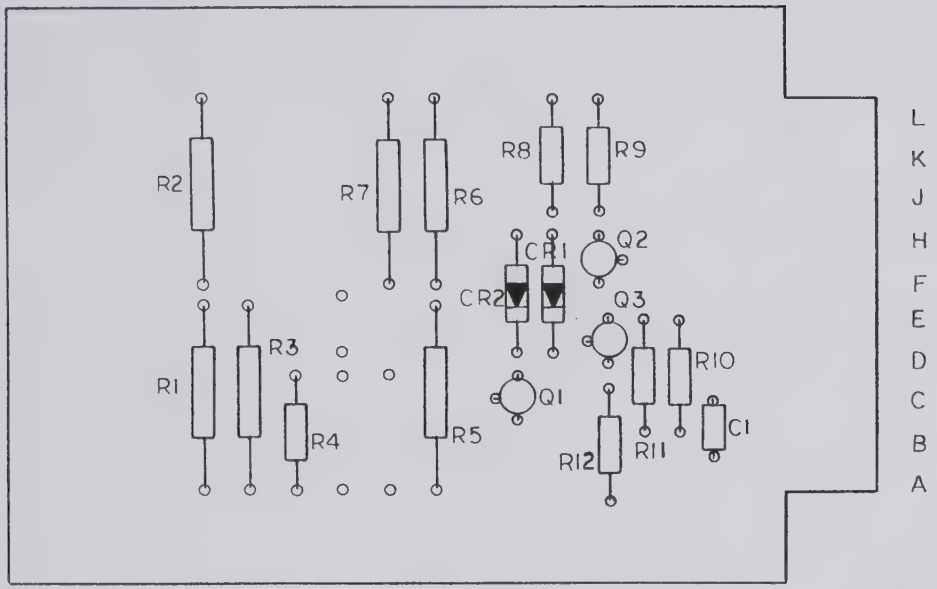
1 REFERENCE DESIGNATIONS ON THIS ASSEMBLY ARE ABBREVIATED. ADD ASS'Y DESIGNATION AS PREFIX TO FORM COMPLETE DESIGNATION.

2 UNLESS OTHERWISE SPECIFIED:
RESISTANCE IN OHMS
CAPACITANCE IN PICOFARADS

3 SYMBOL * INDICATES SELECTED COMPONENT. AVERAGE VALUE SHOWN.

TOLERANCES (EXCEPT AS NOTED)	ROCKLAND LABS, INC.		
DECIMAL ±		SCALE	DRAWN BY J.R.
			APPROVED BY SNT
FRACTIONAL ±	TITLE FEEDBACK ASS'Y A5, A15 SCHEMATIC DIAGRAM		
ANGULAR ±	DATE 10-14-68	DRAWING NUMBER 112522	

DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.



TOLERANCES (EXCEPT AS NOTED)	ROCKLAND LABS INC.		
DECIMAL ±		SCALE 2/1	DRAWN BY WK APPROVED BY SNT
FRACTIONAL ±	TITLE FEEDBACK ASSY A7, A17		
ANGULAR ±	DATE 2/11/69	DRAWING NUMBER 112525	REV.

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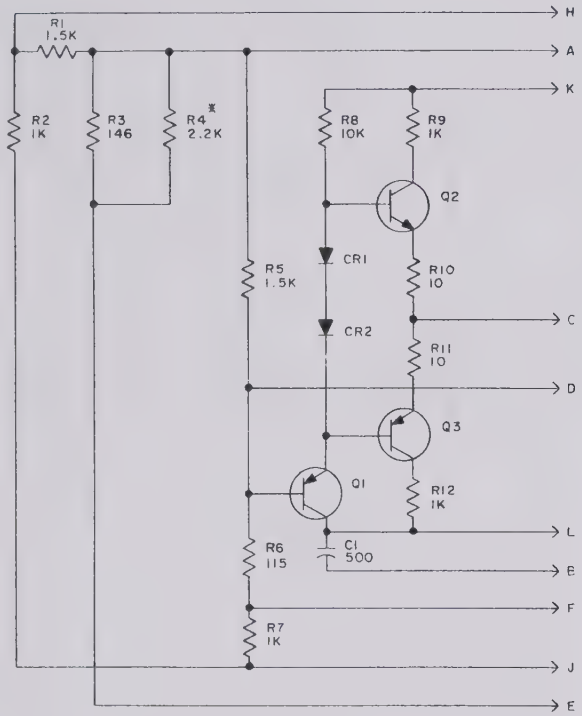
MADE IN U.S.A.

DATE	BTM	REVISION RECORD	AUTH.	DR.	CK.

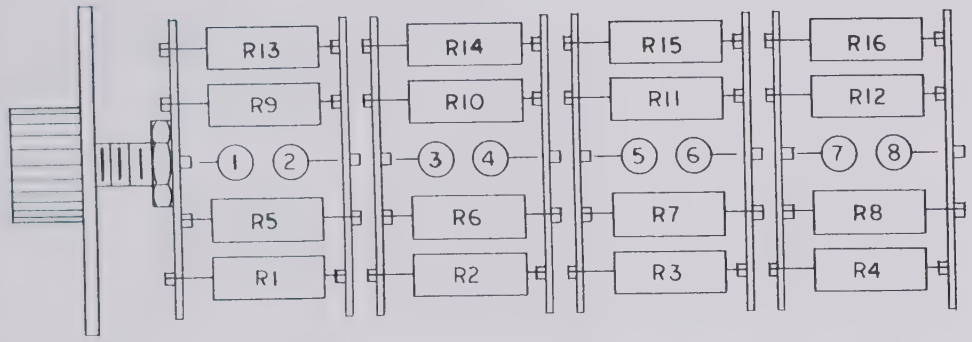


NOTES:

1. REFERENCE DESIGNATIONS ON THIS ASSEMBLY ARE ABBREVIATED. ADD ASS'Y DESIGNATION AS PREFIX TO FORM COMPLETE DESIGNATION.
2. UNLESS OTHERWISE SPECIFIED:
   RESISTANCE IN OHMS.
   CAPACITANCE IN PICOFARADS.
3. SYMBOL * INDICATES SELECTED COMPONENT AVERAGE VALUE SHOWN

TOLERANCES (EXCEPT AS NOTED)	ROCKLAND LABS. INC.		
DECIMAL ±		SCALE	DRAWN BY J.B.
			APPROVED BY SJT
FRACTIONAL ±	TITLE FEEDBACK ASSY A7, A17 SCHEMATIC DIAGRAM		
ANGULAR ±	DATE 2/17/69	DRAWING NUMBER 112526	REV.

DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.



ASSEMBLY A8, A9, A10, A18, A19, A20

TOLERANCES (EXCEPT AS NOTED)	ROCKLAND LABS INC.		
DECIMAL ±		SCALE	DRAWN BY W. KLINZMAN APPROVED BY SNT
FRACTIONAL ±	TITLE CUTOFF FREQUENCY SELECTOR SWITCH		
ANGULAR ±	DATE 11-6-68	DRAWING NUMBER 112440	

DIAL SETTING	pts. 1 & 2	pts. 3 & 4	pts. 5 & 6	pts. 7 & 8
0	open	open	open	open
1	R1	R2	R3	R4
2	R5	R6	R7	R8
3	R1,R5	R2,R6	R3,R7	R4,R8
4	R13	R14	R15	R16
5	R5,R9	R6,R10	R7,R11	R8,R12
6	R5,R13	R6,R14	R7,R15	R8,R16
7	R9,R13	R10,R14	R11,R15	R12,R16
8	R1,R9,R13	R2,R10,R14	R3,R11,R15	R4,R12,R16
9	R5,R9,R13	R6,R10,R14	R7,R11,R15	R8,R12,R16
10	R1,R5,R9,R13	R2,R6,R10,R14	R3,R7,R11,R15	R4,R8,R12,R16

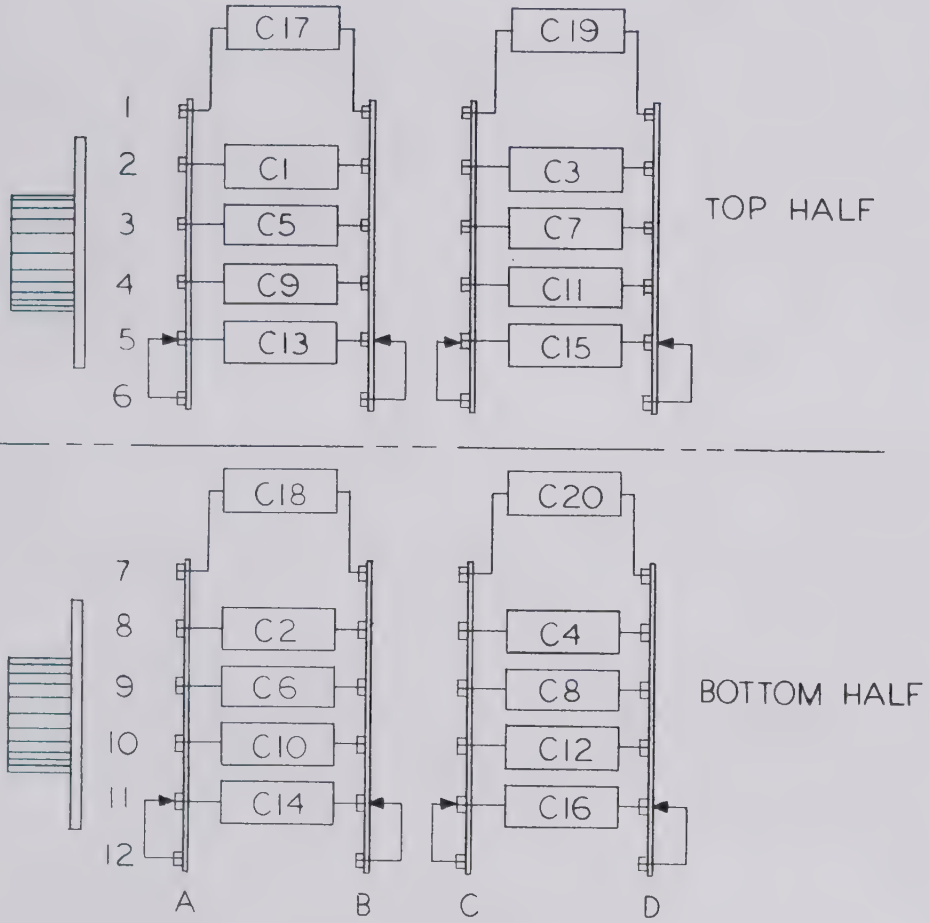
NOTES:

1. Reference designations are abbreviated. Add assembly designation as prefix to form complete designation.
2. Table shows connection of pts. indicated to the opposite ends of the parallel combination of resistors shown.

ASSEMBLY A8, A9, A10, A18, A19, A20

ROCKLAND LABORATORIES, INC.	
CUTOFF FREQUENCY SELECTOR SWITCH TRUTH TABLE	
11-10-68	112441

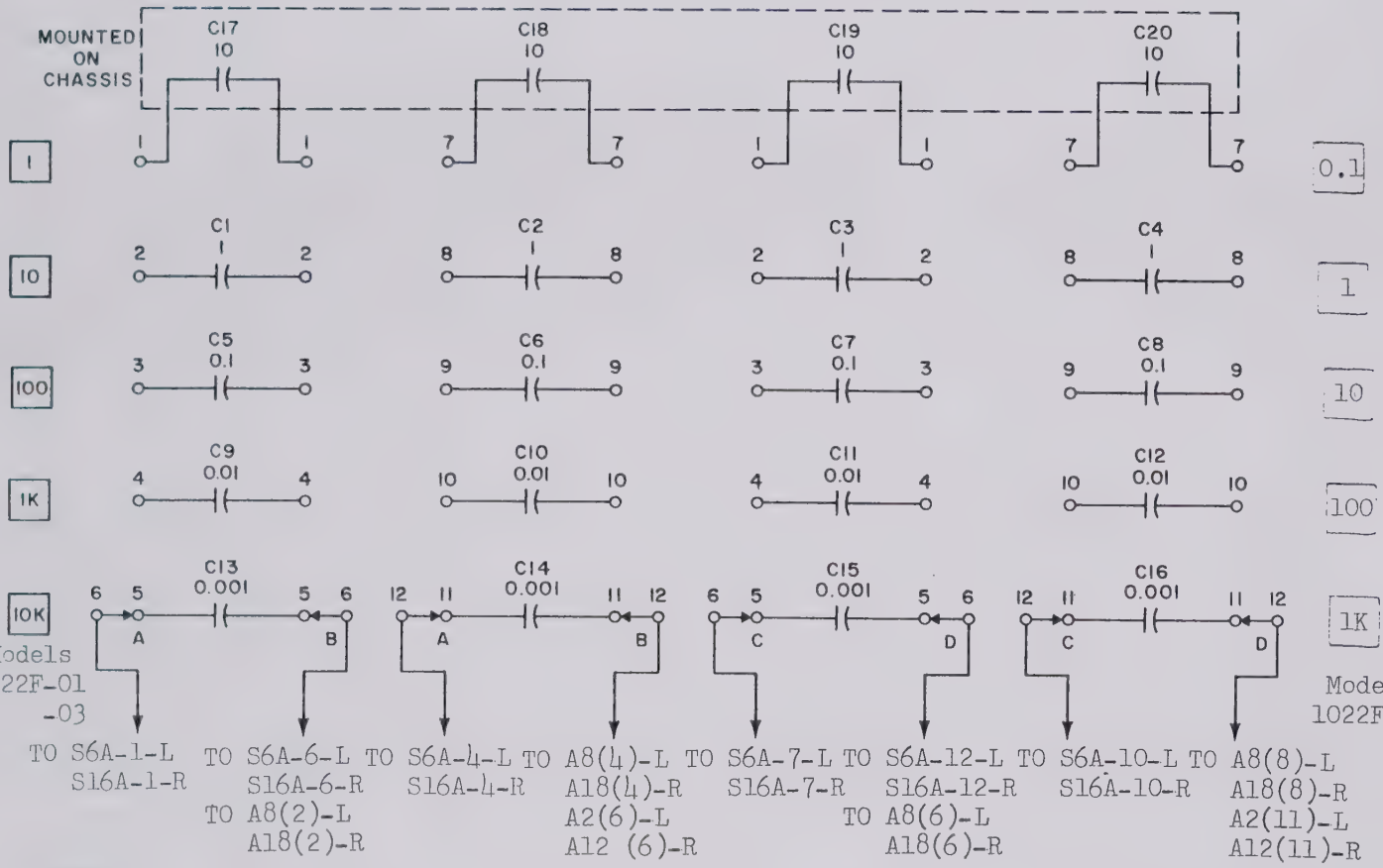
DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.



ASSEMBLY A11, A21

TOLERANCES (EXCEPT AS NOTED)	ROCKLAND LABS INC.		
DECIMAL ±		SCALE	DRAWN BY W. KLINZMAN APPROVED BY SNT
FRACTIONAL ±	TITLE MULTIPLIER SWITCH		
ANGULAR ±	DATE 11-9-68	DRAWING NUMBER 112460	

DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.



Models 1022F-01 -03

TO S6A-1-L S16A-1-R

TO S6A-6-L S16A-6-R TO A8(2)-L A18(2)-R

TO S6A-4-L S16A-4-R

TO A8(4)-L A18(4)-R A2(6)-L A12 (6)-R

TO S6A-7-L S16A-7-R

TO S6A-12-L S16A-12-R TO A8(6)-L A18(6)-R

TO S6A-10-L S16A-10-R

TO A8(8)-L A18(8)-R A2(11)-L A12(11)-R

Models 1022F-02 -04

ASSEMBLY A11, A21

NOTES:

1. REFERENCE DESIGNATIONS ON THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY DESIGNATION AS PREFIX TO FORM COMPLETE DESIGNATION.
2. CAPACITANCE VALUES IN MICROFARADS.
3. DELETE C17, C18, C19, C20 IN MODELS 1022F-03, -04.

TOLERANCES (EXCEPT AS NOTED)	ROCKLAND LABS , INC.		
DECIMAL ±		SCALE	DRAWN BY J.R.
			APPROVED BY SNT
FRACTIONAL ±	TITLE MULTIPLIER SWITCH ASS'Y SCHEMATIC DIAGRAM		
ANGULAR ±	DATE 10-27-68	DRAWING NUMBER 112561	

6.0 REPLACEABLE PARTS LIST

6.1 INTRODUCTION

This section contains information on replaceable parts. Only parts with reference designation numbers are listed. Items such as hardware trim, etc. are not included.

6.2 ORDERING INFORMATION

To order replacement parts, address your order to ROCKLAND LABORATORIES, INC., P.O. Box 57, Tappan, New York 10983. Items with reference designation may be ordered by specifying Model No., Serial No., and complete reference designation or by RLI Part No. where applicable. All other items may be ordered by description.

6.3 ASSEMBLY DESIGNATION

Table 6-1 lists all the assemblies of the instrument, their reference designations, and the RLI Part Numbers. For physical location of each assembly, refer to Fig. 5-1.

Table 6-1 ASSEMBLY DESIGNATIONS

ASSEMBLY	LEFT CHANNEL	RIGHT CHANNEL	MODEL	RLI PART NO.
Power Supply	A1		A11	112420
Motherboard	A2	A12	A11	112515
Op-Amp, 1st stage	A3	A13	A11	112315
Op-Amp, 2nd stage	A4	A14	A11	112315
Feedback, 2nd stage	A5	A15	A11	112520
Op-Amp, 3rd stage	A6	A16	A11	112540
Feedback, 3rd stage	A7	A17	A11	112525
Cutoff Freq. 1st digit	A8	A18	1022F-01, 03 1022F-02, 04	112440 112340
Cutoff Freq. 2nd digit	A9	A19	1022F-01, 03 1022F-02, 04	112340 112345
Cutoff Freq. 3rd digit	A10	A20	1022F-01, 03 1022F-02, 04	112345 112350
Multiplier	A11	A21	A11	112460
Extender Card	None		A11	112365

POWER SUPPLY ASS'Y A1

REFERENCE DESIGNATION	DESCRIPTION
A1	Board Ass'y, Power Supply, includes C1, C2, CR1 thru CR5, Q1 thru Q4, R1 thru R9
C1, C2	C: fxd, mylar, .01 ufd, 10%, 100 vdcw
CR1, CR2, CR3, CR4	Rectifier, 1A, 200 PRV, 1N4003
CR5	Diode, zener, 6.8v, 10%, 1N754
Q1, Q2	Transistor, NPN, Si, 2N3565
Q3, Q4	Transistor, PNP, Si, 2N4249
R1, R2	R: fxd. comp, 10K, 5%, 1/4w
R3	R: fxd. met. flm, 1.5K, 1%
R4, R5, R6	R: fxd. met. flm, 10K, 1%, 1/4w
R7	R: fxd. met. flm, 5.9K, 1%, 1/4w
R8, R9	Potentiometer, WW, 1.5K, 1/4w
	CHASSIS-MOUNTED PARTS
C1, C2	C: fxd, electrolytic, 1400 MFD, 50 vdcw
C3	C: fxd, mylar, 0.1 MFD, 600 vdcw
F1	Fuse, 1/4A Slow-Blow
PL1, PL2	Lamp incandescent, 28 vdc
Q1, Q2	Transistor NPN, Si power, 2N5296
S1	Switch, toggle, SPDT
S2	Switch, slide, DPDT, 115/230v
S3	Switch, slide, DPDT
T1	Transformer, power 115/230 vac, 50-400 Hz

MOTHERBOARD ASS'Y A2, A12

REFERENCE DESIGNATION	DESCRIPTION
A2, A12	Board Ass'y, Motherboard, includes C1 thru C18, CR1 thru CR4, J1 thru J5, R1 thru R12
C1	C: var. mica, 2-25 pf, 175 vdcw
C2	C: fxd, mica, 100 pf, 10%, 500 vdcw
C3	C: fxd, tantalum, 1 uf, 20%, 35 vdcw
C4	C: fxd, mica, 47 pf, 10%, 500 vdcw
C5	C: fxd, mylar, 0.01 uf, 10%, 100 vdcw
C6	C: same as C5
C7	C: same as C3

MOTHERBOARD ASS'Y A2, A12

REFERENCE DESIGNATION	DESCRIPTION
C8	C: fxd, mica, 22 pf, 10%, 500 vdcw
C9	C: same as C5
C10	C: same as C5
C11	C: same as C1
C12	C: same as C4
C13	C: same as C5
C14	C: same as C5
C15	C: same as C1
C16	C: same as C4
C17	C: fxd, electrolytic, 50 uf, 25 vdcw
C18	C: same as C17
CR1	Diode: Silicon, 80 prv, 1N457
CR2	Diode: same as CR1
CR3	Diode: zener, 12 v, 10%, 1N759
CR4	Diode: same as CR3
J1 thru J5	Connector: P.C., 10-pin, female
R1	R: fxd, met. flm, 9M, 1%, $\frac{1}{2}$w
R2	R: fxd, met. flm, 1M, 1%, $\frac{1}{4}$w
R3	R: fxd, comp, 2.2K, 5%, $\frac{1}{4}$w
R4	R: fxd, comp, 1K, 5%, $\frac{1}{4}$w
R5	R: fxd, comp, 10K, 5%, $\frac{1}{4}$w
R6	R: same as R5
R7	R: fxd, comp, 100 ohms, 5%, $\frac{1}{4}$w
R8	R: fxd, met. flm, 6.0K, 1%, $\frac{1}{4}$w
R9	R: fxd, met. flm, 10K, 1%, $\frac{1}{4}$w
R10	R: same as R7
R11	R: same as R7
R12	R: fxd, comp, 47 ohms, 5%, $\frac{1}{4}$w

OP-AMP ASS'Y A3, A4, A13, A14

REFERENCE DESIGNATION	DESCRIPTION
A3, A4, A13, A14	Board Ass'y, Op-Amp, includes C1 thru C4, CR1 thru CR3, Q1 thru Q10, R1 thru R13
C1	C: fxd, mylar, .0015 uf, 10%, 100 vdcw
C2	C: fxd, mica, 100 pf, 10%, 500 vdcw
C3	C: fxd, mica, 100 pf, 10%, 500 vdcw
C4	C: not assigned

OP-AMP ASS'Y A3, A4, A13, A14

REFERENCE DESIGNATION	DESCRIPTION
CR1 thru CR3	Diode: Silicon, 80 prv, 1N457
Q1, Q2	Transistor: J-FET, Matched pair, MFE-2093 or equivalent
Q3, Q4	Transistor: Silicon, NPN, matched pair, 2N3565
Q5	Transistor: Silicon, NPN, 2N3565
Q6	Transistor: Silicon, PNP, 2N4249
Q7	Transistor: same as Q6
Q8	Transistor: same as Q5
Q9	Transistor: same as Q5
Q10	Transistor: same as Q6
R1	R: fxd, comp, 4.7K, 5%, $\frac{1}{4}$w
R2	R: same as R1
R3	R: fxd, met. flm, 7.96K, 1%, $\frac{1}{4}$w
R4	R: var. flm, 5K
R5	R: same as R3
R6	R: same as R1
R7	R: fxd, comp, 100K, 5%, $\frac{1}{4}$w
R8	R: fxd, comp, 27K, 5%, $\frac{1}{4}$w
R9	R: fxd, comp, 1K, 5%, $\frac{1}{4}$w
R10	R: fxd, comp, 2.2K, 5%, $\frac{1}{4}$w
R11	R: same as R9
R12	R: fxd, comp, 220 ohms, 5%, $\frac{1}{4}$w
R13	R: same as R12

FEEDBACK ASS'Y A5, A15

REFERENCE DESIGNATION	DESCRIPTION
A5, A15	Board Ass'y, Feedback, includes C1, C2, CR1, CR2, Q1 thru Q3, R1 thru R12
C1	C: fxd, mica, 500 pf, 10%, 500 vdcw, selected value
C2	C: fxd, mica, 100 pf, 10%, 500 vdcw
CR1, CR2	Diode: Silicon, 80 prv, 1N457
Q1	Transistor: Silicon, PNP, 2N4249
Q2	Transistor: Silicon, NPN, 2N3565
Q3	Transistor: same as Q1
R1	R: fxd, met. flm, 1.5K, 1%, $\frac{1}{4}$w
R2	R: fxd, met. flm, 1K, 1%, $\frac{1}{4}$w
R3	R: fxd, met. flm, 4.99K, 1%, $\frac{1}{4}$w

FEEDBACK ASS'Y A5, A15

REFERENCE DESIGNATION	DESCRIPTION
R4	R: fxd, comp, 1K, 5%, $\frac{1}{4}$w, selected value
R5	R: fxd, comp, 27K, 5%, $\frac{1}{4}$w, selected value
R6	R: same as R1
R7	R: same as R2
R8	R: fxd, comp, 10K, 5%, $\frac{1}{4}$w
R9	R: fxd, comp, 1K, 5%, $\frac{1}{4}$w
R10	R: fxd, comp, 10 ohms, 5%, $\frac{1}{4}$w
R11	R: same as R10
R12	R: same as R9

OP-AMP ASS'Y A6, A16

REFERENCE DESIGNATION	DESCRIPTION
A6, A16	Board Ass'y, Op-Amp, same as A3, A4, A13, A14 except for the following changes
C3	C: not assigned
C4	C: fxd, mica, 22 pf, 10%, 500 vdcw

FEEDBACK ASS'Y A7, A17

REFERENCE DESIGNATION	DESCRIPTION
A7, A17	Board Ass'y, Feedback, includes C1, CR1, CR2, Q1 thru Q3, R1 thru R12
C1	C: fxd, mica, 500 pf, 10%, 500 vdcw
CR1, CR2	Diode: Silicon, 80 prv, 1N457
Q1	Transistor: Silicon, PNP, 2N4249
Q2	Transistor: Silicon, NPN, 2N3565
Q3	Transistor: same as Q1
R1	R: fxd, met. flm, 1,5K, 1%, $\frac{1}{4}$w
R2	R: fxd, met. flm, 1K, 1%, $\frac{1}{4}$w
R3	R: fxd, met. flm, 146 ohms, 1%, $\frac{1}{4}$w
R4	R: fxd, comp, 2.2K, 5%, $\frac{1}{4}$w, selected value
R5	R: same as R1

FEEDBACK ASS'Y A7, A17

REFERENCE DESIGNATION	DESCRIPTION
R6	R: fxd, met. flm, 115 ohms, 1%, $\frac{1}{4}$w
R7	R: same as R2
R8	R: fxd, comp, 10K, 5%, $\frac{1}{4}$w
R9	R: fxd, comp, 1K, 5%, $\frac{1}{4}$w
R10	R: fxd, comp, 10 ohms, 5%, $\frac{1}{4}$w
R11	R: same as R10
R12	R: same as R9

CUTOFF FREQUENCY SELECTOR SWITCH ASS'Y A8, A18
1st DIGIT, MODEL 1022F-01, 1022F-03

REFERENCE DESIGNATION	DESCRIPTION
A8, A18	Switch Ass'y, CUTOFF FREQUENCY selector includes R1 thru R16, S1
R1 thru R4	R: fxd, met. flm, 15.9K, 1%, $\frac{1}{4}$w
R5 thru R8	R: fxd, met. flm, 7.96K, 1%, $\frac{1}{4}$w
R9 thru R12	R: fxd, met. flm, 5.31K, 1%, $\frac{1}{4}$w
R13 thru R16	R: fxd, met. flm, 3.98K, 1%, $\frac{1}{4}$w
S1	Switch, Rotary, BCD (1-2-3-4), 11-position

CUTOFF FREQUENCY SELECTOR SWITCH ASS'Y A9, A19
2nd DIGIT, MODEL 1022F-01, 1022F-03

REFERENCE DESIGNATION	DESCRIPTION
A9, A19	Switch Ass'y, CUTOFF FREQUENCY selector includes R1 thru R16, S1
R1 thru R4	R: fxd, met. flm, 159K, 1%, $\frac{1}{4}$w
R5 thru R8	R: fxd, met. flm, 79.6K, 1%, $\frac{1}{4}$w
R9 thru R12	R: fxd, met. flm, 53.1K, 1%, $\frac{1}{4}$w
R13 thru R16	R: fxd, met. flm, 39.8K, 1%, $\frac{1}{4}$w
S1	Switch, Rotary, BCD(1-2-3-4), 11-position

CUTOFF FREQUENCY SELECTOR SWITCH ASS'Y A10, A20
3rd DIGIT, MODEL 1022F-01, 1022F-03

REFERENCE DESIGNATION	DESCRIPTION
A10, A20	Switch Ass'y, CUTOFF FREQUENCY selector includes R1 thru R16, S1
R1 thru R4	R: fxd, met. flm, 1.59M, 1%, $\frac{1}{4}$w
R5 thru R8	R: fxd, met. flm, 796K, 1%, $\frac{1}{4}$w
R9 thru R12	R: fxd, met. flm, 531K, 1%, $\frac{1}{4}$w
R13 thru R16	R: fxd, met. flm, 398K, 1%, $\frac{1}{4}$w
S1	Switch, Rotary, BCD (1-2-3-4), 11-position

CUTOFF FREQUENCY SELECTOR SWITCH ASS'Y A8, A18
1st DIGIT, MODEL 1022F-02, 1022F-04

REFERENCE DESIGNATION	DESCRIPTION
A8, A18	Switch Ass'y, CUTOFF FREQUENCY selector includes R1 thru R16, S1
R1 thru R4	R: fxd, met. flm, 159K, 1%, $\frac{1}{4}$w
R5 thru R8	R: fxd, met. flm, 79.6K, 1%, $\frac{1}{4}$w
R9 thru R12	R: fxd, met. flm, 53.1K, 1%, $\frac{1}{4}$w
R13 thru R16	R: fxd, met. flm, 39.8K, 1%, $\frac{1}{4}$w
S1	Switch, Rotary, BCD (1-2-3-4), 11-position

CUTOFF FREQUENCY SELECTOR SWITCH ASS'Y A9, A19
2nd DIGIT, MODEL 1022F-02, 1022F-04

REFERENCE DESIGNATION	DESCRIPTION
A9, A19	Switch Ass'y, CUTOFF FREQUENCY selector includes R1 thru R16, S1
R1 thru R4	R: fxd, met. flm, 1.59M, 1%, $\frac{1}{4}$w
R5 thru R8	R: fxd, met. flm, 796K, 1%, $\frac{1}{4}$w
R9 thru R12	R: fxd, met. flm, 531K, 1%, $\frac{1}{4}$w
R13 thru R16	R: fxd, met. flm, 398K, 1%, $\frac{1}{4}$w
S1	Switch, Rotary, BCD (1-2-3-4), 11-position

CUTOFF FREQUENCY SELECTOR SWITCH ASS'Y A10, A20
3rd DIGIT, MODEL 1022F-02, 1022F-04

REFERENCE DESIGNATION	DESCRIPTION
A10, A20	Switch Ass'y, CUTOFF FREQUENCY selector includes R1 thru R16, S1
R1 thru R4	R: fxd, met. flm, 15.9M, 1%, $\frac{1}{2}$w
R5 thru R8	R: fxd, met. flm, 7.96M, 1%, $\frac{1}{2}$w
R9 thru R12	R: fxd, met. flm, 5.31M, 1%, $\frac{1}{2}$w
R13 thru R16	R: fxd, met. flm, 3.98M, 1%, $\frac{1}{2}$w
S1	Switch, Rotary, BCD (1-2-3-4), 11-position

MULTIPLIER SWITCH ASS'Y A11, A21

REFERENCE DESIGNATION	DESCRIPTION
A11, A21	Switch Ass'y, MULTIPLIER, includes C1 thru C16, S1
C1 thru C4	C: fxd, polycarb. 1.0 ufd, 1%, 200 vdcw
C5 thru C8	C: fxd, polycarb. 0.1 ufd, 1%, 200 vdcw
C9 thru C12	C: fxd, polycarb. 0.01 ufd, 1%, 200 vdcw
C13 thru C16	C: fxd, silv. mica, 0.001 ufd, 1%, 500 vdcw
S1	Switch, Rotary, 8-pole, 5-pos, shorting

CHASSIS MOUNTED PARTS,
MODEL 1022F-01 & MODEL 1022F-02 ONLY

C17 thru C20	C: fxd, polycarb. 10 ufd, 1%, 200 vdcw

MISCELLANEOUS PARTS

REFERENCE DESIGNATION	DESCRIPTION
J6, J7	Binding post assembly, multipurpose
J8 thru J15	Not assigned
J16, J17	Binding post assembly, multipurpose
S4	Switch, toggle, SPDT
S5	Switch, toggle, DPDT
S6	Switch, rotary, 8-pole, 2-position
S7 thru S13	Not assigned
S14	Same as S4
S15	Same as S5
S16	Same as S6

WARRANTY

Our instruments are warranted against defects in materials and workmanship for one year from the date of shipment.

We will repair or replace products which prove to be defective during the warranty period.

For assistance contact your nearest RLI Sales Representative, or write to:

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